

Nucleus:

- Two parts:

- Proton \rightarrow charge = $+1.6 \times 10^{-19} \text{ C}$
 $m_p = 1.67 \times 10^{-27} \text{ kg} = 1.007 \text{ amu}$

- neutron \rightarrow charge = 0 C
 $m_n = 1.67 \times 10^{-27} \text{ kg} = 1.008 \text{ amu}$

- Forces:

- Strong \rightarrow works over
very short distances
($\sim 10^{-15}$)

- \rightarrow enough strength to
combat electromagnetic
force of repulsion between
protons

- Weak \rightarrow decay

- At some point, size of nucleus
becomes too large and strong
nuclear force can't hold
nucleus together

- Decay happens

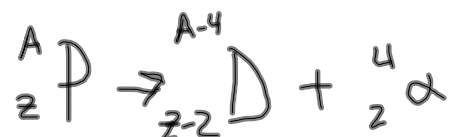
- Isotope \rightarrow atom with same number of
protons and different number of neutrons

Types of Decay:

- Alpha decay:

- α -particle is $2p^+$ and $2n^0$

- Decay equation:



A = atomic mass ($\#p^+ + \#n^0$)

Z = atomic number ($\#p^+$)

P = parent particle

D = daughter particle

α = alpha particle

- Beta decay:

- Neutron-to-proton ratio

- $Z \leq 20$, atoms "want"
ratio of $N/Z = 1$

- Atom will change neutron to
proton or vice versa to get
 N/Z ratio closer to 1

- This is called beta (β) decay

• Beta decay continued:

- Parity \rightarrow atom "likes"

p^+ and n^0 to be in pairs

- 279 stable nuclei

Z	N	# Stable Nuclei
Even	Even	168
Even	Odd	57
Odd	Even	50
Odd	Odd	4

- Examples:

- Boron-12

$$p^+ = 5 \quad n^0 = 7$$

stable?

Does $N/Z = 1$? No

Parity \rightarrow odd/odd

NOT Stable

This will β -decay to change

$n^0 \rightarrow p^+$. This changes

atom to ^{12}C , giving $N/Z = 1$

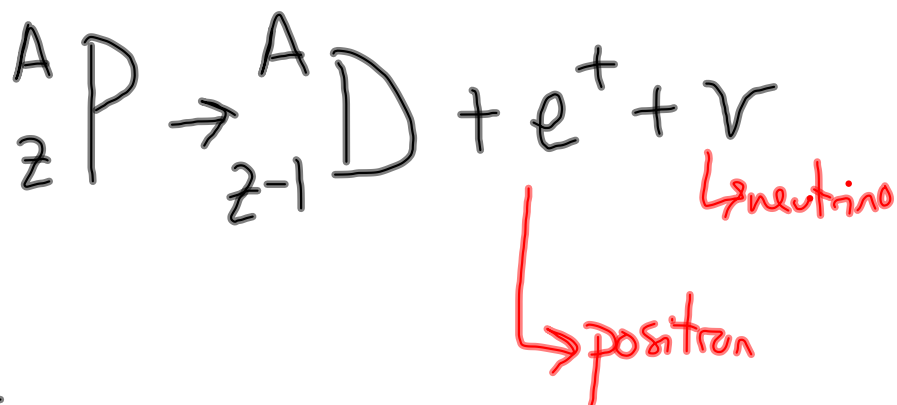
and parity is even/even

- Example: ^{12}N $p^+ = 7, n^0 = 5$

If there are more p^+ than n^0 , atom is unstable.

Convert p^+ to n^0 , giving ^{12}C

- β^+ -decay:
proton \rightarrow neutron



- β^- -decay: neutron \rightarrow proton

